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ABSTRACT

A developmental model of literacy based on language and cognitive skills is presented in this paper. Two independent learning strands suggested as major factors in achieving literacy are learning to understand language by eye (reading) as skillfully as one can understand language by ear (auding) and learning to use the printed medium for literacy task performance in understanding various graphic displays using iconic, linguistic, and schematic representations. Examples of advanced information processing skills involved in the latter are presented and explained. A study designed to assess discrepancies between auding and reading skills of adults in a literacy training program used the Durrell Listening Reading Test and obtained auding scores for the adults of only the fifth-grade level. In a second study, it was observed that adults who scored at the eighth-grade level on a standardized reading test may be less developed than a group of average fifth-grade readers in automaticity of decoding. This and other studies surveyed suggest that learning to understand language by eye as skillfully as by ear may take several years after the initial decoding has been mastered. (MKM)

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The Acquisition of Literacy by Children and Adults

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It seems appropriate at this Symposium, whose topic is *The Acquisition of Reading*, to attempt to better understand the relationship of reading to the broader concept of *literacy*. Much of the concern for reading is expressed as concern for literacy--the problem being that many people in our society, and in developing, third-world societies are illiterate, or unsuitably literate for the demands of modern civilization. As Miller has put it:

> "On the one hand, knowledge is becoming increasingly necessary for survival, and literacy is the key tool for the acquisition of that knowledge. On the other hand, the teaching of reading in our public schools--especially in the ghettos, both urban and rural--is failing badly, and all subsequent education built on reading fails with it." (p. 376)

In addition to expressing the ever-increasing need for literacy in a world burgeoning with knowledge, and in which the gathering, synthesizing, and generation of new knowledge provides some of the more lucrative opportunities for employment, Miller expresses the generally held view of literacy as "the key tool" for acquiring knowledge. He then implies that because the teaching of reading is so bad, many people do not learn to read well, and since reading is a major part of literacy, and since literacy is required for acquiring the knowledge offered by the educational system, many people will not be able to acquire that knowledge and will be "...barely tolerated at a level of existence we call 'welfare'." (p. 375)

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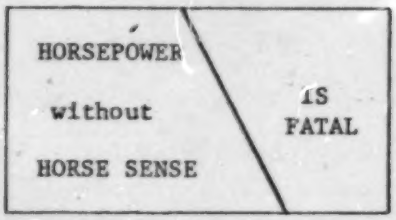
Problems in Understanding the Nature of Literacy

The way in which we conceptualize the nature of reading and its relationship to literacy will determine the types of training and education programs we develop, and the types of research programs we pursue to contribute to the solution of reading and literacy problems. For this reason we need to have as clear an understanding as possible of what we mean by literacy and reading, and how these concepts relate to the acquisition of knowledge.

Evidence abounds which indicates that there is currently considerable lack of consensus as to what literacy means, and how knowledge, reading, and literacy interrelate. For example, here is an item from the National Assessment of Educational Progress: Reading (1972).

The person being tested is presented the following sign:



They are then asked: Where would you probably see this sign?
(They are given the instruction to mark the correct alternative.)

		Percent Correct by Age			
		9	13	17	Adult
On a highway	X	23.3	44.6	75.7	88.4
On a gymnasium floor	___				
At a racetrack for horses	___	64.3	47.2	17.6	7.0
In a grocery store	___	(Percent choosing this alternative)			
I don't know	___				

The point to remember about this item is that it occurred within an assessment battery which purports to assess our nation's achievement in *reading*; those who marked the third alternative would be scored incorrect and their reading capability and hence the nation's reading capability would be challenged. Yet, in this study, and others like it of recent vintage (Murphy, 1975; Northcutt, 1975) there is no check to find out whether lack of reading skill or lack of specific knowledge may be the prime reason for lack of correct performance on many items. Presumably, if the problem was solely one of not being able to comprehend the *written* message, then, if the message were presented in *spoken* form, the respondent would have no trouble in selecting the correct answer.

In a recently completed project for the United States Office of Education, Adult Education Division, literacy was conceived of as "composed of an application of the communications (reading, writing, speaking, listening), computation, problem solving, and interpersonal relations skills to the general areas of occupational knowledge, consumer economics, community resources, government and law, and health" ! (Northcutt, 1975, p. 44.) In this case then, literacy is not *a* "tool skill" for acquiring knowledge, as Miller states; rather, it is a *set* of "tool skills" *plus* knowledge of particular content domains. This project has produced a set of test items similar to many of those in the National Assessment of Educational Progress, in that they fail to distinguish between reading ability or lack of knowledge. Yet, important conclusions about *reading* are reached - "About one-fifth of the sample could not *read* an equal opportunity notice well enough to identify a verbal statement which defined

its meaning." - based upon such ambiguous data. In this study, one-fifth of this adult sample would suggest that 20+ million adults have a serious *reading* problem! Today the results of this study are being widely used to design curricula for adult literacy programs.

A major difference between the perspectives of educational researchers such as cited above, and a large number of other researchers, in regard to the nature of reading and hance the nation's "reading problem", is succinctly presented by Jenkins and Liberman (1972):

> "At all events the 'reading problem' as we know it would not exist if, in dealing with language, all children could do as well by eye as they do by ear." (p. 1)

According to this view, in which writing is construed as an alternative input display to speech, the "reading problem" is one of getting to learn the knowledge of sight-sound correspondences, and to develop skill in using this knowledge to the point of being able to comprehend printed messages with the same degree of accuracy and efficiency as they could comprehend the message if it were presented in spoken form.

From the foregoing, it seems that many researchers have wished to limit the concept of literacy to that of an alternative, graphic, method of representing the spoken language (writing) and learning to comprehend the graphic representation of language (reading) by eye as well as one could previously comprehend the acoustic representation of language by ear. (The text edited by Kavanagh and Mattingly, 1972, contains a fairly representative sample of researchers who have been participants in the large-scale Project Literacy effort and other efforts where the focus has been on reading as "decoding print to speech".)

While educators and lay persons have also included the notions of "reading as a substitute for listening to spoken language" within their concept of literacy, they have further expanded the meaning of "reading" to include the knowledge of "general" vocabulary and concepts, and the learning of new skills for perceiving information from graphic displays, which involve both linguistic and non-linguistic features (tables, graphs, maps, etc.). Thus, as in the NAEP example above, and in various "reading" tests, students can score low in "reading" because of lack of specific vocabulary or other knowledge, their lack of skill in processing information from special graphic displays, or their lack of skill in languaging by eye as well as they can by ear (as well as other factors, such as low motivation, etc.). Furthermore, "reading" training programs usually go well beyond simply teaching the encoding and decoding into graphic material of what one already knows, and include the teaching of specific knowledge in various content areas. Thus, the term "reading training" is regarded as synonymous to "literacy training".

A General Model of the Development of Literacy Skills

Because of the confusion regarding "reading" and "literacy", with its frequent detrimental effects in the assessment, teaching, and researching of reading, a group of us at the Human Resources Research Organization's Western Division in Monterey, California, have found it useful to conduct research and development projects on the design of literacy training programs following the conceptual guidance of a simple model of the major components and processes involved in the development of literacy skills.

In this section I will first briefly describe the model of the development of literacy skills as given in Sticht, *et al.* (1974) and present some evidence for the model's general validity. Next I will discuss some research based on the model which we have conducted with children and adults. The first study describes research to assess discrepancies between auding and reading skills of adults in a literacy training program. The second study concerns the measurement of automaticity in decoding in children and adults who are in literacy training. These studies suggest that learning to language by eye as well as one can language by ear may take considerably longer than we thought.

The Developmental Model: Figure 1 presents the developmental model of literacy in schematic form. Briefly, the model formally recognizes what common sense tells us, and that is that, when a child is first born, he or she is born with certain Basic Adaptive Processes for adapting to the world around them. These BAP include certain information processing capacities for acquiring, storing, retrieving, and manipulating information. This stored information processing capacity forms a cognitive content which, in its earlier forms is pre-linguistic (Figure 1; Stage 1). After some time though, the child develops skills for receiving information representing the cognitive content of others, and for representing his own cognitive content to others. This is accomplished through the specialization of the information processing activities of listening, looking, uttering, and marking (Figure 1, Stage 2). The specialization is one of use of these skills for the express purpose of externally representing one's own thoughts for others to interpret, and forming internal representations of the external representations of

others' thoughts that they make. More specifically though, the particular specialization of present concern is the representation of thoughts via the use of conventionalized signs (words) and rules for sequencing these signs (syntax) in speaking and auding (listening to speech in order to language) (Figure 1, Stage 3).

Finally, if the child is in a literate society, he may acquire the specialized looking and marking skills of reading and writing. For present purposes, we presume that we are talking about the "typical" case in our literate society, and assert that children typically learn to read and write (Figure 1, Stage 4).

A further aspect of the developmental model, is that it holds that the development of the oracy skills requires the development of the cognitive content through intellectual activity which we call conceptualizing ability. In other words, the development of the oracy skills of speaking and auding follows and is built upon a pre-linguistic cognitive content and conceptualizing ability. Said plainly, the child must have something to think about before the need for a language ability for sharing thoughts can and needs to arise. It is important that it be understood that this early, pre-linguistic cognitive content, or *knowledge*, is what will form the foundation for the acquisition of new knowledge over the lifetime of the person. Thus Miller's concern for the child's acquisition of literacy skills to obtain survival knowledge, must be traced back to the child's pre-linguistic acquisition of knowledge, and later his acquisition of knowledge of and via the oral language (learning by being told, Carroll, 1968). We see, then, that knowledge itself is the

primary "tool skill" for acquiring further knowledge - whether by oracy or by literacy skills.

A final aspect of the model is that it asserts that the literacy skills utilize the same conceptual base (cognitive content; conceptualizing ability; knowledge) as is used in auding and speaking, *and* utilizes the same signs and rules for sequencing those signs as is used in the oral language skills for receiving and expressing conceptualizations. Notice that this is an assertion based upon the developmental sequence, i.e., the literacy skills are built upon existing oracy skills as the end of a developmental sequence. This does not mean that once literacy skills are acquired, that they do not contribute anything new to knowledge or language capability; clearly they do. What is asserted is that when the literacy skills are initially acquired, they are essentially to be construed as a second way of utilizing the same language system the child uses in speaking and auding. Presumably this is what Jenkins & Liberman refer to as being able to use language by eye as well as it is used by ear.

Closing the Language by Ear and By Eye Gap: A fundamental hypothesis derivable from the developmental model is that a child's ability to comprehend language by auding will surpass his ability to comprehend language by reading during the early years of school until the reading skills are acquired, at which time ability to comprehend language by auding and by reading should become equal.

Though this seems to me like a very basic relationship to be explored if one is interested in understanding the acquisition of ability to language by eye as well as by ear, it turns out that there is, to my knowledge, absolutely no research specifically designed to find out (1) how well non-literates can comprehend language by ear, and (2) how long they require to learn to comprehend language by eye as well as they do by ear. In other words, how long, typically, does it take to "crack the code?" Some (*cf.*, Chall, 1973) have speculated that it takes about the first three grades; others (Smith, 1975, p. 188) assert that learning to read may take, typically, only a few weeks (for 15 year old adolescents)!

In the absence of well-designed studies which might reveal something of the closing of the "gap" between languaging by ear and by eye, Sticht, *et al.* (1974) reviewed some 44 studies which measured how well subjects at different grade levels could comprehend messages presented in spoken versus written form. Figure 2 summarizes this review and shows, for each grade level the proportion of studies in which auding was found superior to (A>R); equal to (A=R) or inferior to (A<R) reading. It should be cautioned that these studies represent a wide variety of methods, messages, difficulty levels, response modes, etc.

With these concerns in mind, the data of Figure 2 suggest that, clearly, children have not learned to comprehend by reading as well as they can comprehend by auding by the third grade. Learning to language by eye as well as one can language by ear may require as long as seven years or thereabouts, since it is at the seventh grade level where one has a fifty-fifty chance of finding studies showing auding > reading, and studies showing auding ≤ reading.

Though, as mentioned, these data must be regarded with caution, there is some interesting additional circumstantial evidence that the learning to decode period may last as long as 7 or 8 years. One piece of evidence comes from the study of eye movement records which indicate that it is not until the eighth grade that the adult pattern of eye movements is typically achieved (Tinker, 1965, pp. 81-84). A second piece of evidence suggesting that learning to decode may take quite a while to fully develop comes from the work of Durrell & Brassard (1969). These researchers developed a test to measure the "gap" between a person's ability to comprehend language by auding and by reading. The test includes four parts: vocabulary knowledge assessed via spoken and written modes, and comprehension of brief paragraphs presented in spoken and written forms. The data for a national norming sample (N = 22,247) indicate that auding and reading performance on the paragraph comprehension tests became equal during the sixth grade, while auding performance surpassed reading performance on the vocabulary knowledge subtests through the eighth grade. On the vocabulary and paragraph tests combined, auding and reading scores became equal in the eighth grade.

Comparisons of silent reading rates to typical auding rates provide additional evidence to suggest that it is around the seventh or eighth grade that the reading decoding process typically achieves the same degree of automaticity as is involved in auding. Data from the National Assessment of Educational Progress: Reading Rate (see Sticht, *et al.*, 1974, p. 95) indicate that the silent reading rate for 13-year olds (seventh and eighth graders) is around 175 wpm (words per minute). Earlier, Foulke and Sticht (1969) reported that the average oral reading aloud rate of professional newscasters and readers for the blind is around 175 wpm. If this latter figure is regarded as a typical auding rate (because it is the rate professionals read aloud to be auded), then the silent reading rates of 13-year olds closely matches the auding rates required when auding newscasts and similar formal spoken presentations. This might be construed as suggesting that reading and auding are operating with comparable degrees of automaticity of decoding at this age/grade level.

These various, tenuous pieces of evidence suggest that one aspect of learning to read can indeed be considered as learning to language by eye as well as one can by ear. This is evidenced by the data that show that ability to comprehend by auding occurs first in the developmental sequence, and the person who acquires reading skill acquires the ability to comprehend by reading what he could earlier comprehend only by auding. Furthermore, this evidence suggests that, on the average, this aspect of learning to read may stretch from the first grade to the sixth, seventh, or eighth grades. While it is not clear what exactly

is occupying all this time, especially beyond the third or fourth grade, which reading specialists have traditionally considered the time frame for the "learning to read stage", it seems likely that this large time span is necessary for the child to develop full automatization of the reading decoding skill (LaBerge & Samuels, 1973).

If this analysis is correct, then perhaps learning to decode may be divided into two phases: in phase one the child acquires the basic know-how of decoding, while in phase two the decoding skills are practiced and overlearned to the point of becoming completely automatic. This might correspond to the rapid growth and plateaus found in the development of many psychomotor skills. In this case, the rapid growth might correspond to the traditional "learning to read stage" (first three years of schooling) while the plateau would correspond to the development of full automaticity of decoding during the fourth to seventh or eighth years. (It should be noted that the data of Figure 2 suggest the possibility of even a third phase of learning to read, the stage in which some people appear to become more effective at getting information from texts than they are from spoken messages, as is the case for average high school seniors and collegians. This seems to represent a situation in which one is *better* able to language by eye than by ear, and may correspond to the phase in psychomoter skill development which occurs after the plateau phase. The NAEP data reported above suggests that most people do not acquire this post-plateau level of skill.)

Studies of Learning to Language by Eye with Adults

In the foregoing discussion, learning to decode has been defined as that component of reading acquisition in which one becomes able to comprehend the written language as well as one can the spoken language. Learning to decode was further conceived as consisting of two phases. In phase 1, the early acquisition phase of learning to read, the person achieves the capability of decoding printed materials well enough to read and understand what he can aud and understand - though the reading is not done with the same fluency with which auding is performed. In phase 2, however, the reading decoding skills are practiced and overlearned to a level of automaticity comparable to that used in auding.

The studies to be described next are concerned with problems in measuring the phase 1 and phase 2 skill levels with adult students of reading.

Measuring the Gap Between Auding and Reading Skills: In the course of our work to develop a reading program for adults (*cf.*, Sticht, 1975; Sticht, *et al.*, 1975), we have been concerned with understanding various aspects of "the reading problem" the students exhibit. One thing we have considered is the extent to which their problem may be one of simply not being able to language by eye as well as they can by ear--the reading problem as defined by Jenkins & Liberman (1972).

To estimate the size of the "gap" between student's abilities to comprehend by auding and reading, we administered the Durrell Listening (called auding herein) and Reading Series Test: Intermediate Level (see

Sticht & Beck, 1975, for a more complete description of this research, including results of additional testing of the auding-reading "gap", and a critique of tests for this purpose). The tests were administered to 116 male students in a literacy program in Northern California. Their ages ranged from 17 to 32 years, with a mean age of 19.5 years. School grades completed averaged 11.1, with a range from 7 to 16 (!). Over half had a high school diploma or equivalency certificate. Forty-five of the students spoke English as a Second Language, and were designated as the ESL group. Seventy-one spoke English as a Primary Language, and were designated the EPL group.

The Durrell Listening Reading Test provides three major pieces of information, all expressed in grade levels herein: a norm-referenced score on how well students can comprehend by auding; a norm-referenced score on how well they can comprehend by reading; and a derived score on what the reading level is that corresponds to the student's auding score; this latter information is called the reading "potential" score. Figure 3 presents a schematic model of the relationships of auding and reading over the early school years, and explains the auding, reading, and reading potential scores further.

Each of the three major pieces of information is divisible into two scores: one for vocabulary knowledge, and the other for paragraph comprehension. This information, along with the combined scores, is presented for the EPL and ESL groups separately in Table 1.

Looking first at Part C of Table 1, we can see that, even if these students learn to read as well as they can aud, they are going to have problems, because, while they are adults, most having high school or equivalency diplomas, their auding scores are at the 5th (EPL) and 3rd (ESL) grade levels.

Part B of Table 1 presents reading grade level scores, while Part A presents reading potential scores for EPL and ESL students. It is immediately apparent that these two groups differ considerably. For one thing, on the average, the EPL students are reading somewhat below their reading potential scores (5.8-4.9 = 0.9 grade levels for total scores), while the ESL students appear to be reading *above* their reading potential level (4.1-4.8 = -0.7 grade levels for total scores). This reflects the fact that the ESL students score very low on their ability to comprehend the spoken language (3rd grade level). No doubt we are detecting here what many of us have personally experienced in studying a foreign language: it is much easier to read the language than it is to comprehend it in spoken form. Since most of the ESL students in this study had studied English in school, they developed more skill in reading than in auding the language.

Table 2 presents additional analyses emphasizing differences between results for the vocabulary and paragraph subtests for EPL and ESL students. Part A shows for the vocabulary subtests the number of students having reading potential scores greater than reading scores (RP>R); reading scores greater than reading potential scores (R>RP);

and equal reading potential and reading scores (RP=R). Here we see a complete reversal of the pattern for EPL and ESL students, with more than 80% of the EPL students showing RP>R, while over 75% of the ESL students show R>RP.

Part B of Table 2 shows an enhanced effect for ESL students, with some 85% showing R>RP, while the EPL students show equal proportions having RP>R and R>RP. Though it is not certain what produced the differences between the vocabulary and paragraph subtests for EPL students, one possibility is that the memory load for the vocabulary subtest is more nearly equal in the auding and reading modes than it is in the paragraph subtests. In the Durrell Listening-Reading Series, the reading paragraphs are available throughout the response period, while the auding paragraphs are read aloud by the examiner, and then the questions are asked. This places a much heavier load on memory during the auding paragraph test. This would operate then to *underestimate* the differences between comprehending by auding and reading.

Whatever the case, it seems from these data that many of the EPL students operate at such a low level of competence in the oral language that even if they learned to language by eye as well as they do by ear, they would still be some 5-6 grade levels below the average high school senior, and hence "the reading problem" in this case must be more broadly conceived to include a large "language problem".

Examining the Automaticity of Decoding Skills in Adult Literacy Students: As developed above, the second phase of learning to decode is the period during which the pupil develops *automaticity* of decoding. This means that the processing of print has become as automatic as the processing of speech, and is done in a completely unconscious manner, with the focus of attention on the conceptualizations being formed in accord with the printed message.

Because of the importance of acquiring automaticity, we have explored a method of evaluating a person's level of automaticity of decoding. Whereas it is possible to indirectly assess automaticity by measuring reading rate and comprehension, it is not clear in such instances when a low reading rate implies poor decoding or difficulty of comprehension. If reading rate is high, while comprehension is low, this may indicate that the reader skipped parts of the material. Since most procedures for measuring comprehension as a covariant of reading rate involve immediate retention tests of comprehension, it is not clear to what extent low comprehension may reflect a memory storage/retrieval problem rather than a decoding problem.

Ideally, what we would like is an "on-line" measure of decoding skill during silent reading, which could be coupled with an immediate retention test to serve as an indicator of information storage. However, this ideal is not attainable (at least we do not know how to attain it) hence an approximation to this ideal was sought. The procedure we finally

developed consisted of presenting a simple story (5th grade level to be within the language level of the students) to be read while at the same time the story was presented in spoken form to be auded. Then we arranged that at times during the presentation, there would occur a different, though semantically appropriate, word in the spoken message from what appeared on the printed page. For instance, the printed story might state "With the air of a *lord* he walked...", while the spoken story would state "With the air of a *prince* he walked...". When students encountered a mismatch, they were instructed to circle the printed word which did not match the spoken word. In order to perform this task, then, the students had to continually decode the print into a form comparable to the spoken word, and perform an internal comparison. To determine different levels of skill in performing this task, the audio tapes were time compressed to produce speech rates of 228 and 328 words per minute, while the uncompressed rate was 128 wpm.

To gain additional evidence that the "tracking" task described above (detecting mismatches between audio and printed words) does indeed involve continuous decoding, we prepared a second version of the same material, but in this case the mismatch word was replaced on the printed page by three words (see example), one of which matched the word in the spoken message. The student's task was then to circle the matching words.

Example: With the air of a prince / king / lord he walked...

With such an arrangement, the student is able to skip a lot of the decoding required in the former task, because he has a cue as to where his next decision must be made. We refer to this version of the tracking task as the "cued" version, while the first version is called the "uncued" tracking task.

The story used was a fifth grade version of *Roland and Charlemagne*. The first third of the story was presented at 128 wpm, the second third at 228, and the final third at 328 wpm. After each third of the selection, 15 4-alternative multiple choice questions were answered by the students. All questions called for retention of detail—no inference or reasoning items were included. These tests thus provided immediate retention indicators of comprehension.

Two groups of literacy students were used. One group (N=18, mean reading grade level = 4.6 on the Metropolitan Intermediate Achievement Test: Reading) received the cued treatment, while a second group received the uncued treatment (N=20; reading grade level = 5.2).

Figure 4 presents the results of the two treatments; Part A presents the tracking data; Part B the immediate retention data. Of major interest is the difference between the curves for the cued and uncued tracking data (Part A). At the 128 wpm rate, the students in the uncued task scored only 60% correct on detection of mismatches. When the cues were added, this detection score increased to practically 100% correct. This adds credence to the notion that the tracking task does involve "on-line" decoding of print.

The fact that there is no difference to speak of between the immediate retention scores of the cued and uncued tasks at the 128 wpm

condition, may reflect a ceiling effect on the test (in fact, a group of college students scored only 85% correct on the test when administered following the same procedure as used in the present work). Why the cued group scored somewhat below the uncued group on the immediate retention tests is not clear (nor important to the present discussion) though it may reflect the fact that the mean reading level for the cued group was about 0.6 grade level below that of the uncued group.

The decline in the tracking and immediate retention scores for both the cued and uncued groups as the rate of speech was increased indicates that the ability of the students to both store information *and* perform the decoding task was impaired. This suggests that the use of accelerated speech rates can be used to stress the students' information processing capabilities, and that ability to withstand this information processing overload, by keeping decoding and retention scores high, can indicate a higher level of skill in these capabilities.

Based on the above reasoning, the *cued* treatment was administered to a group of 5th grade students, reading at the 5th grade level; a group of young men in a literacy school, reading at the 8th grade level; and a group of out of school young men reading above the 11th grade level.

Figure 5 shows the data for these groups and the data for the cued treatment from Figure 4, A. Part A shows the tracking (decoding) scores. Of interest here is that, while all groups were equally capable at the 128 wpm rate, differences among the groups appear at the faster rates. Surprisingly, the 5th grade students performed better than

either of the literacy training groups, even though one of these groups read at the 8th grade level (as determined by the Metropolitan Achievement Test, Intermediate Level, 1968). The 5th graders also retained (Part B) information as well as the adult literacy students who read at the 8th grade level, and outperformed the adults reading at the 4th grade level. In both the tracking and immediate retention tasks, the college students excelled, with only trivial effects of rate to speak of.

I take the data of Figure 5, Part A; Tracking, to indicate differences in the automaticity of decoding skills among these four groups. A point of major concern for those interested in adult reading training is, I believe, that adults who score, on the average, at the 8th grade level on a standardized test, may be less developed than a group of average (in terms of reading scores) 5th graders in automaticity of decoding. If, as suggested earlier, the development of automaticity ordinarily requires 3-5 years beyond the 3rd grade for the "typical" child growing up in our K-12 school curriculum, then we must consider that the development of comparable automaticity will require considerable time for adults who are learning to read. But adults in literacy training programs are typically interested in rapid acquisition of reading skills; and indeed numerous adult literacy programs exist which purport to "teach reading" very rapidly. And, as reported earlier, some researchers seem to think that adolescents might learn to read in "...a few weeks" (Smith, 1975, p. 188). Perhaps the phase one skills of learning to read may be acquired fairly rapidly, but

full automaticity would seem to require extensive practice in reading over an extended period of time.

Clearly, the data presented here are only exploratory and anything but definitive; nonetheless I believe they should cause us to consider further the problems, instructional and operational, of developing and assessing full automaticity of decoding in adult and childhood reading programs.

Learning to Use the Printed Medium for Literacy Task Performance

As discussed above, one aspect of becoming literate is to learn to use the printed code with the same efficiency as one uses the spoken code in auding, i.e., to read efficiently.

A second aspect of achieving literacy involves learning to use the printed medium for performing a variety of tasks which demand a variety of information processing skills in addition to reading. Many of the tasks will require writing; most will require repeated reading of some materials; and still others require reading while examining non-linguistic displays. It is in the performance of various tasks in which written materials are used that the unique properties of writing, and the printed media in general, appear to come to contribute most to the development of "literacy", as contrasted with "reading".

The unique aspects of written messages which set them apart from spoken messages are (1) they are more-or-less permanent; and (2) they are spatially arrayed. Because written messages are permanent (i.e., not occurring on-line as in a live speech) and arranged spatially (both on a page and as a volume of pages when in book form) they can be *surveyed* so that readers can mobilize such related knowledge as they may have to

relate the information in the text to what they know (i.e., to comprehend, Smith, 1975). Because the text is more-or-less permanent, it is *referable*, i.e., the reader can flip back and forth to preview and review; the text can be returned to at a later date for rehearsal of what was previously read.

The reader may have recognized the foregoing as a paraphrase of Robinson's (1961) well-known reading study skills method, the SQ3R procedure. This procedure calls for first *surveying* a chapter (or other segment of writing), and noting headings, italicized words, topic sentences, etc., to form a general idea about what is in the material to be learned. Then the student *questions* himself about what is likely to be found in the reading; then the student *reads* the material, *recites* to himself the major points encountered and how they relate to the questions he formed; and finally, at a later date, the student *reviews* the chapter once again. Clearly, this procedure reflects the nature of text as spatially arrayed and more-or-less permanent.

It is only because texts are pre-existing and permanent to a degree that the very complex literacy tasks such as referred to by Adler & Van Doren (1972) as *syntopical* reading can be performed. Such tasks involve the type of activities as are engaged in when preparing a "state-of-the-art" review; or when preparing a scholarly text, such as Huey's (1968) text on reading. Such tasks may take years to perform, and dozens of books may be skimmed, surveyed, noted, read, re-read, consulted, examined, and dismissed, etc. This type of literacy activity requires much more than reading; it requires writing, editing, re-writing, discussions with people about the ideas being worked on, and much thinking!

At a considerably less grand level of performance, students may be called upon to write reports of what they have read; they may have to prepare a term paper for which they do considerable reading; they may have to prepare outlines, summaries, "300 word" abstracts, and the like about what they have read. In all of these cases, the reading materials are more than likely available during the production of the report. And it may be that only by attempting to prepare the report that the student becomes fully aware of the range of information in the materials being read. Thus in the course of writing, and after examining one's writing, the significance of what was previously read but discounted may be appreciated. In certain cases, the analysis, and reasoning which may go into trying to write, may transfer to reading, in which case the reader may detect previously undetected inconsistencies in what was previously read, though to my knowledge we have no clear-cut evidence regarding the improvement of reading comprehension by writing (see Stotsky, 1975, for a review of literature in this area).

A particularly unique aspect of reading, as distinct from auding, arises from the fact that the printed word can be arrayed spatially. Thus we find figures and graphs with labeled axes and internal parameters; charts and tables; and illustrations with "call-outs" for identifying parts of the illustration. At times comprehension of what is being read is contingent upon being able to comprehend the accompanying figure, table, etc. At other times, performance of some task, such as repairing a motor vehicle, may require the reading of language arrayed in a special "trouble-shooting" table. In such cases, if the structural properties of the table are not well understood, reading

comprehension may be disrupted, especially if it is necessary to combine information from different parts of the table. Again, we may find that the use of a particular mode of representing thoughts may cause a change in a person's ability to comprehend what he reads. For instance, the use of row x column figures for sorting out treatments in analysis of variance designs may transfer to an almost habitual casting of problems that are read about into similar row x column representations in order to comprehend the various effects and their interactions being discussed. Again, though, I know of no research along these lines.

Though there are certainly other tasks people perform with printed materials, I think the ones discussed above are sufficient to make the point that much of the acquisition of literacy is not simply learning to read, i.e., learning a substitute language system for the oral language system. Rather, a large part of learning to be literate, and perhaps the most important part for acquiring higher levels of literacy, is learning how to perform the many tasks made possible by the unique characteristics of printed displays, their permanence and spatiallity. It may be that it is impossible to sort out the differential contributions to literacy of such activities as studying, writing, studying what one has written and revising, and learning to use graphic information, tables, and various visual representations which combine writing with other visual data. But it is certainly the case that people must be able to perform all of these tasks involving reading if they are to be considered literate.

In the following section, a generalization is presented of the developmental model described earlier. This generalization incorporates the *production* of information displays, linguistic and non-linguistic, into the model, and represents an initial attempt to incorporate some of the literacy tasks described above into the developmental model of literacy.

Generalizing the Simple Model of the Development of Literacy to Include a Broader Range of Literacy Tasks

Earlier I briefly described the simple model of the development of literacy skills shown in Figure 1. There it was pointed out that both speaking and writing are processes for representing thoughts in external displays, which people learn to decode to form internal representations, called conceptualizations, through the processes of auding and reading, respectively. Now it should be noted that there are other methods of representing conceptualizations externally than the linguistic modes. People can draw pictures for instance, or produce gestures or bodily postures. Or we can externally represent thoughts through a combination of linguistic and non-linguistic representations: figures, graphs, tables; we can record our speech and gestures on video cassettes, and so forth.

To bring some order into all of these modes of representation of conceptualizations, I would like to divide them into three main categories: iconic, schematic, and linguistic modes of representation. Now I assume that by means of mental "programs" we have stored in our memories, we are able to externalize certain of our concepts by drawing pictures; it is this type of representation which, following Neisser (1967) and others before him, I refer to as *iconic* representation. *Linguistic* representation of conceptualizations is produced by speech or writing, while *schematic* representations are an admixture of iconic and linguistic representations--for example, flow charts, tables, graphs, etc.--which contain both visual structural features and generally contain linguistic signs in the forms of labels or short phrases.

These various representations are *displays* of information which can be examined by others, i.e., we can consider that there are three categories of *input display*: iconic, schematic, and linguistic which people can attend to. Furthermore, the information in a given type of display—say a linguistic display—may, at times, be representable in some other type of representation— say an iconic representation. For example, information presented in written form might be used as source material from which a picture might be drawn, which could represent essentially the same meaning as in the written message. Thus, for instance, I may write "The cave man threw a rock into the water." This might alternatively be represented as Figure 6.

As another example, I might say that "In our research project we found that as the number of years of education increased, the reading skill level increased up to about the 10th grade, and remained the same thereafter." Alternatively, I might draw Figure 7 and say that: "Figure 7 shows the results of our study. Clearly reading skill is a function of years of education, at least for up to ten years of education."

As a final example, I might wish to explain to someone that:

> You are eligible to apply for an old age pension if you are 65 years old and have contributed to the fund for at least five years. However, if the five years of your contribution were prior to 1970, then you are not entitled to the full pension, but rather to 1/2 pension if you are 65, and 3/4 if you are starting at age 67..."

Alternatively I could represent this as in Figure 8.

As indicated, then, it is possible to express very nearly the same ideas in alternate modes: iconic, schematic, and linguistic. Of course, there are conceptualizations which can only be represented in one or the other modes. And there are cases when representation in one

mode is better for some purpose than an alternative mode.

Using the concept of alternative modes of representation in literacy training: Figure 9 schematizes the manner in which we have used the concept of alternative modes of representation in a literacy training program. We provide input representations in the form of two types of linguistic displays; spoken instructions and a written passage. The student is required to transform the written display into either an iconic display, by drawing a picture representing some portion of the written passage, or a schematic display such as a flow chart or classification table with rows specifying concepts and columns listing attributes, or the like. Having made this linguistic-to-iconic or linguistic-to-schematic transformation, the student is then required to transform his product into a linguistic form again by orally describing what his product depicts.

There are several interesting features of this conceptual approach to literacy training which should be noted: (1) it encompasses the concept of reading as learning to language by eye as well as one can by ear by considering reading as linguistic-to-linguistic transformations of printed words into spoken words; (2) it includes the evaluation of comprehension by paraphrase, as Anderson (1972) recommends, by considering paraphrase as a type of linguistic-to-linguistic transformation; (3) it incorporates methods of indicating comprehension which de-emphasize memory, and which take advantage of the unique properties of printed displays, their permanence and spatiallity, by permitting the source display to remain available while the student searches it to find needed information to transform and represent the information iconically

or schematically; themselves modes of representation which emphasize the spatial display of information in ordered relationships, just as written prose does; (4) it provides a framework for discussing literacy as a "key tool" for acquiring knowledge in a very pragmatic way by interpreting the roles of writers, editors and illustrators as performing various transformations on input displays to create new output displays. For instance, writers study iconic, schematic, and linguistic displays and transform them into linguistic (written) output displays; editors take the output of the writer and perform linguistic-to-linguistic transformations, while the illustrator takes the writer's output and transforms aspects of it into iconic output displays. While this obviously simplifies matters somewhat, it never-the-less provides a pragmatic tie between reading and writing which may be of motivational value when dealing with career-oriented adults; and (5) there is a substantial research base coming available which the "representation transformation" (retran) concept structures and subsumes at a highly superordinate level; for instance, Musgrave & Cohen (1971) discuss methods of transforming certain prose passages into two-way tables of information such that the underlying structure of the information contained in the passage may be perceived more readily and the relationships between its several parts can be considered one at a time. They further discuss the transformation of the two-way tables into lists of stimulus/response terms so that traditional verbal learning studies may be related to prose learning via the mediation of two-way tables. While they emphasize the transformations for studying learning of textual materials, interest can be focused first directly on the transformational

process itself, and secondly to learning, which provides a more complete analysis of textual information processing relevant to the present concerns; Frase (1975) too, has studied prose which can be organized into two-way tables to study learning of textual material, and again we can adapt some of his approaches to study the transformation process itself; Lewis (1970) represents a line of research being pursued by several on the representation of prose texts as logical trees, decision logic tables, and algorithmic flowcharts. This work provides formal principles for transforming narrative instructional texts into representations of the type illustrated in Figure 8; Macdonald-Ross & Smith, 1974, present an extensive bibliography on research concerned with the production of graphs, tables, figures, algorithms, readability (which relates nicely to the linguistic-to-linguistic transformation concept) and other research relevant to the types of transformations we are talking about here.

To date, our experience with the representation transformation concept has been limited to using it as a conceptual link between the development model of literacy outlined in Figure 1, in which we talk about the external representation of internal conceptualizations, and the development of literacy training tasks which utilize the wide range of display types people must learn to be literate with, in addition to narrative prose. We have found that by following the practice of showing an example, providing a demonstration, and then providing for guided practice, many of the yound adults with whom we have worked can learn to perform the desired transformations. From future studies of teacher/student interactions, we hope to better understand the processes involved in executing the various transformations called for.

Summary: What does it mean to achieve literacy, and what are the realistic possibilities for achieving literacy as an adult?

Clearly these are questions of considerable import, and just as clearly, I have not answered them completely in this brief paper. I have, however, attempted to at least open a dialogue so that the consideration of the acquisition of reading - the theme for this symposium - might be viewed in the larger context of the acquisition of literacy.

In response to the question of "What does it mean to achieve literacy?", I have suggested in this paper that there are at least two major, interdependent learning "strands".

1. One is learning to language by eye as well as one can by ear; this is what is meant by learning to read. Further, I have presented evidence to suggest that this aspect of learning may involve two "stages": the learning of the knowledges and skills required to decode printed words into language, and the subsequent practice of this skill until automaticity is acquired.

2. The second major strand overlaps with the first and refers to learning the new vocabulary and concepts found in the printed materials one uses in learning to read, and includes the learning of new skills for processing information from printed displays based on the unique properties of such displays; their permanence and spatiallity. In the section just preceeding this one, I presented a simple conceptual scheme which we have found useful for developing instructional activities to teach some of the advanced literacy skills which result from applying reading to a variety of graphic displays.

In response to the question raised above of "What are the realistic possibilities for teaching adults to read?", I think it is fair to say that data presented suggest that we need to have a much better understanding of the wide variety of adults who are learning to read, and we need to have a dialogue on the funds and effort we are willing, as a nation, to devote to better understanding the problems of adult illiterates or marginally literates. Most evidence of which I am aware today, suggests that most Adult Basic Education programs are able to "hold" students for only very limited amounts of training, say 100 to 200 hours, and may affect a one or two grade level gain in reading skills, as measured by standardized tests (though most of the data of which I am aware may be suspect due to routine failure to consider regression effects). As evidenced herein, being able to read "at the 8th grade level" as an adult, does not necessarily imply that one posseses the automaticity of reading of children who may be even three years below that reading level. Thus, it seems to me that strong attention needs to be given to providing *extensive* reading training for adults, so that automaticity of reading skills can be fully developed, and so that the advanced information processing skills involved in processing various graphic displays can be developed. The very brief efforts which currently abound are not sufficient, in my opinion, to produce effective gains in literacy skills to permit them to function as "key tools" for the acquisition of knowledge of the type and in the amount needed to successfully pursue "the good life" beyond the "level of existence we call welfare".

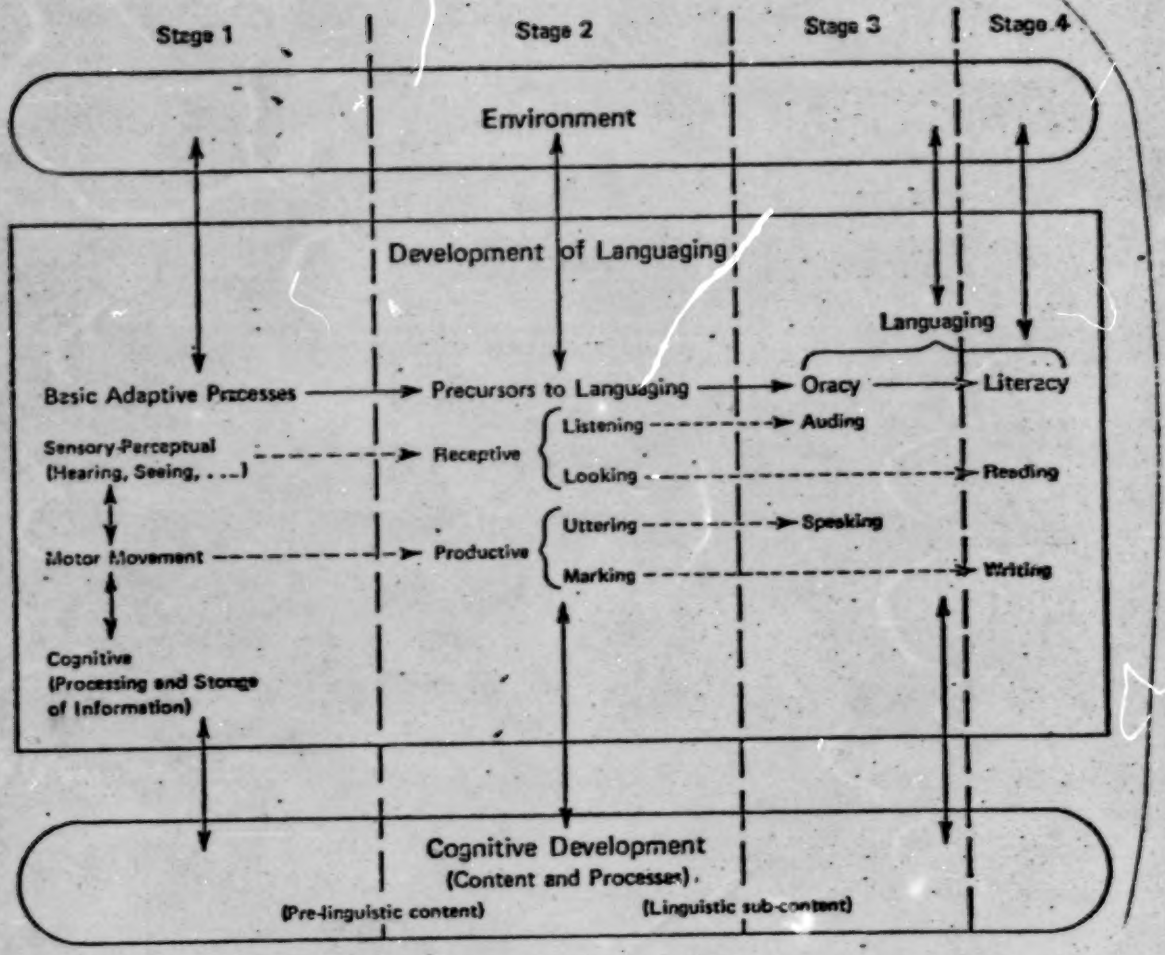

Stage 1
Stage 2
Stage 3
Stage 4
Environment
Development of Languaging
Languaging
Basic Adaptive Processes
Precursors to Languaging
Oracy
Literacy
Sensory-Perceptual
(Hearing, Seeing, . . .)
Receptive
Listening
Auding
Looking
Reading
Motor Movement
Productive
Uttering
Speaking
Marking
Writing
Cognitive
(Processing and Storage
of Information)
Cognitive Development
(Content and Processes)
(Pre-linguistic content)
(Linguistic sub-content)

Figure 1

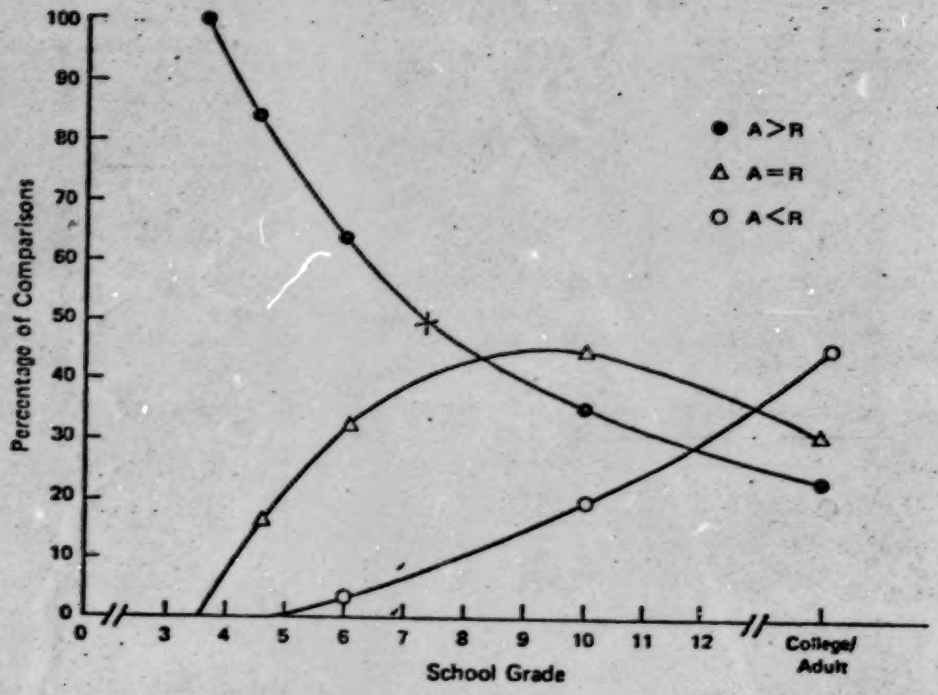

Percentage of Comparisons
100
90
80
70
60
50
40
30
20
10
0
A>R
A=R
A<R
0
3
4
5
6
7
8
9
10
11
12
College/
Adult
School Grade

Figure 2

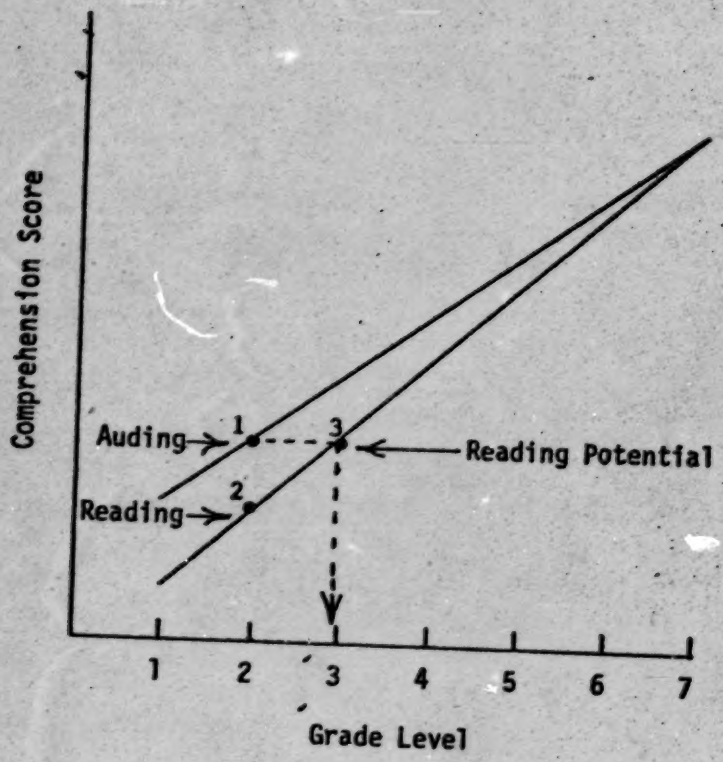

Comprehension Score
Auding
1
3
Reading Potential
Reading
2
1
2
3
4
5
6
7
Grade Level

Figure 3

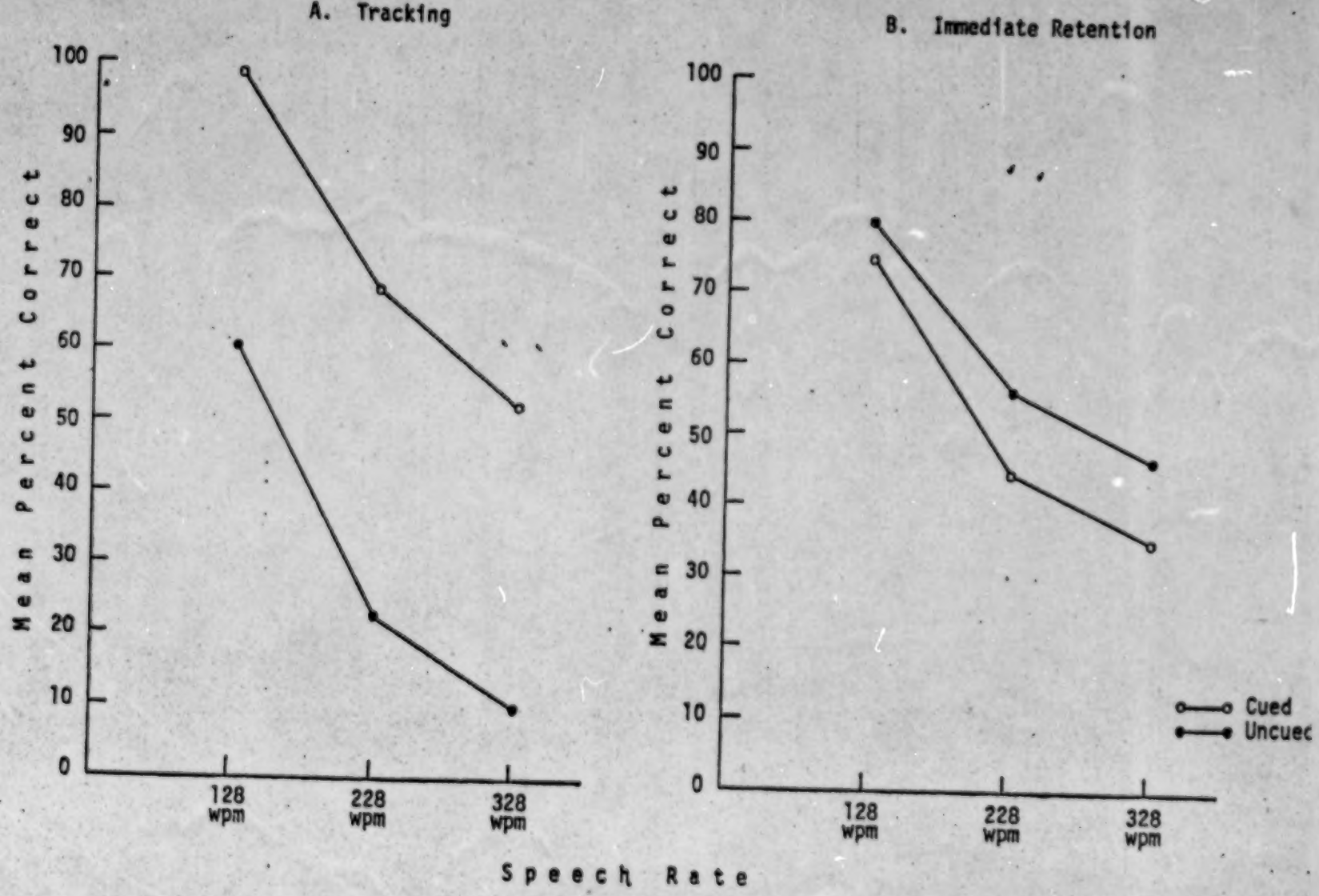

A. Tracking
B. Immediate Retention
Mean Percent Correct
100
90
80
70
60
50
40
30
20
10
0
128 wpm
228 wpm
328 wpm
Speech Rate
Cued
Uncued

Figure 4 37

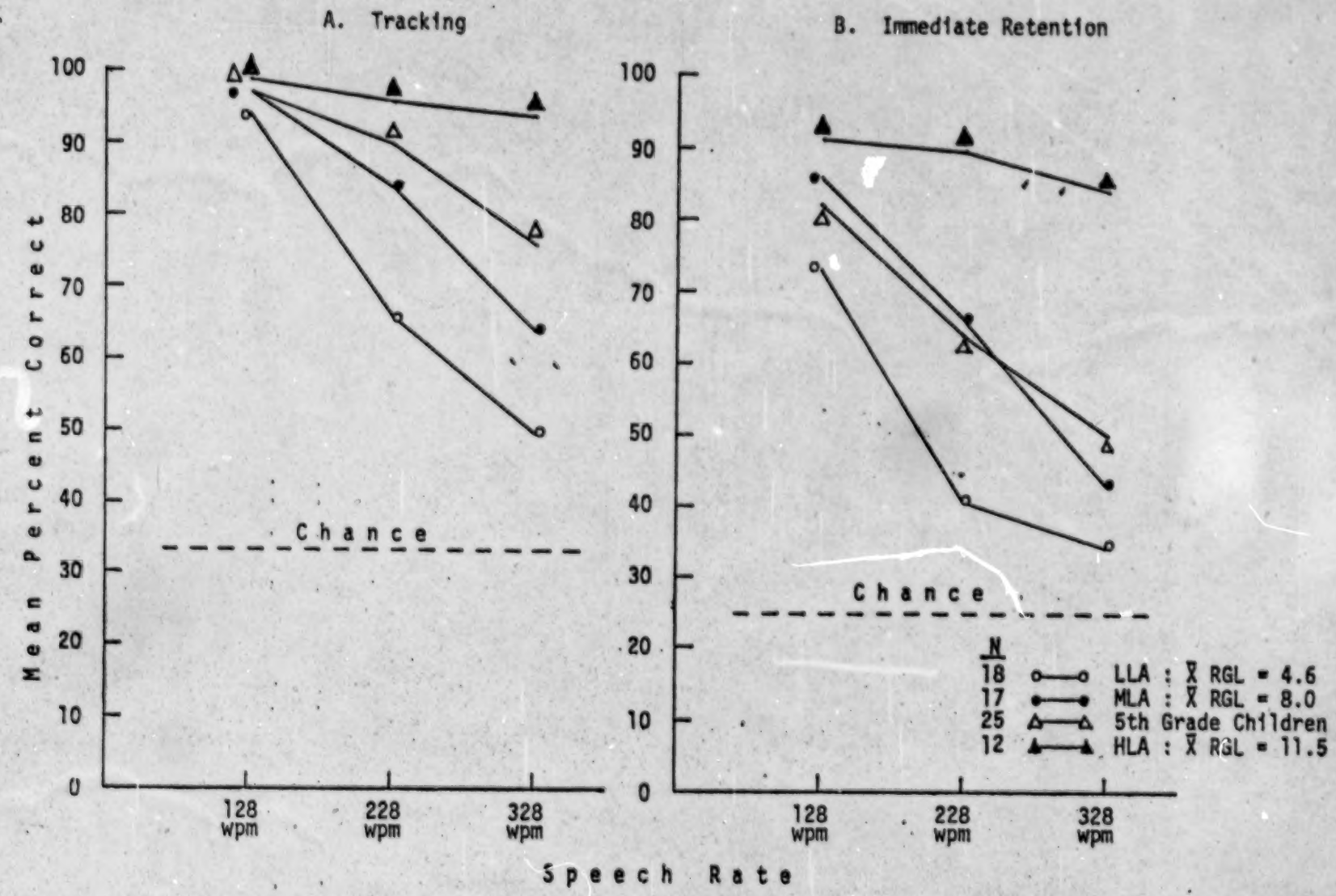

A. Tracking
B. Immediate Retention
Mean Percent Correct
100
90
80
70
60
50
40
30
20
10
0
Chance
128 wpm
228 wpm
328 wpm
Speech Rate
N
18 LLA : X̄ RGL = 4.6
17 MLA : X̄ RGL = 8.0
25 5th Grade Children
12 HLA : X̄ RGL = 11.5

Figure 5

Figure 6

Reading Grade Level
12
11
10
9
8
7
6
5
4
3
2
1
K
K
1
2
3
4
5
6
7
8
9
10
11
12
Grade Level

Figure 7

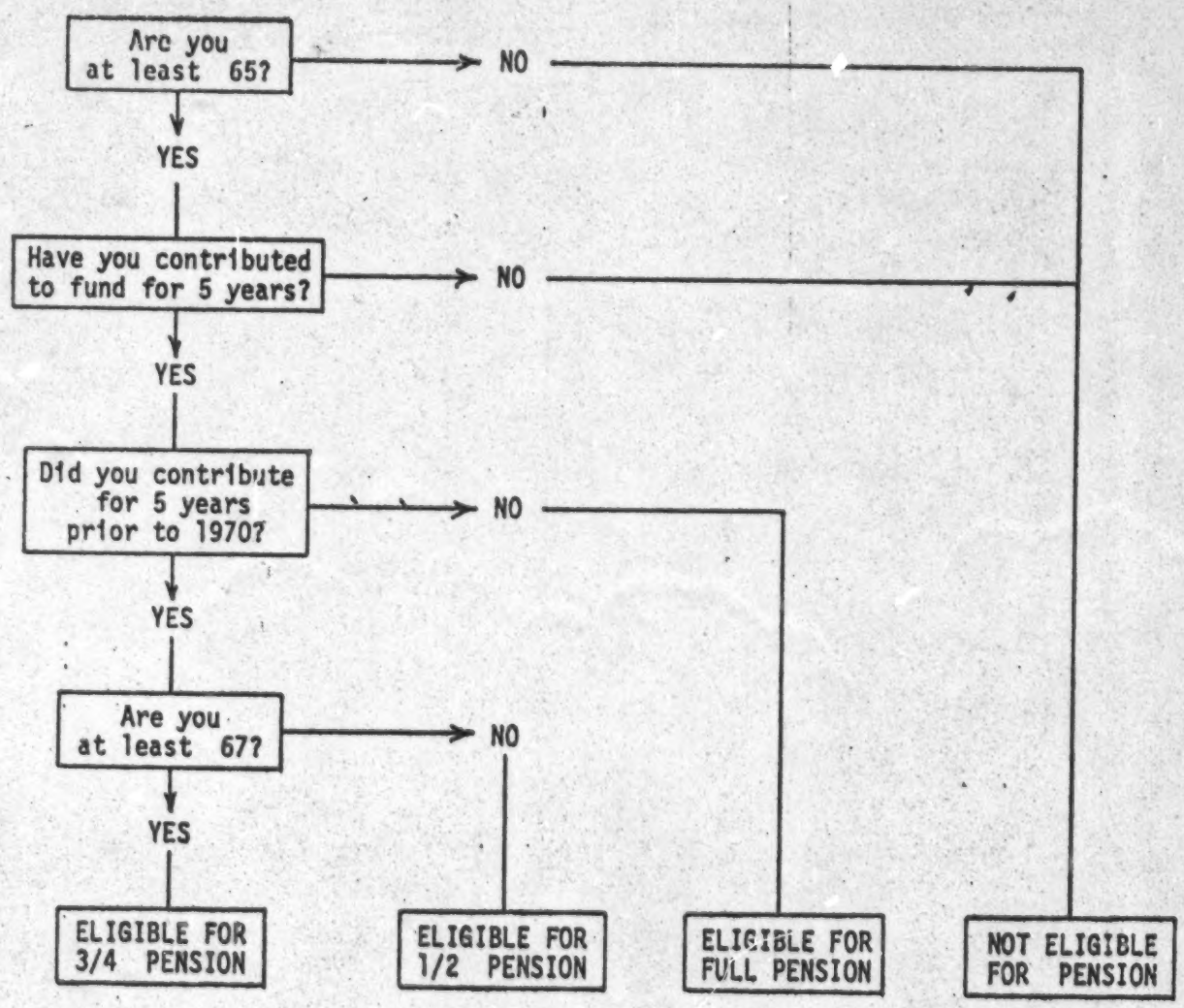

Are you at least 65?
NO
YES
Have you contributed to fund for 5 years?
NO
YES
Did you contribute for 5 years prior to 1970?
NO
YES
Are you at least 67?
NO
YES
ELIGIBLE FOR 3/4 PENSION
ELIGIBLE FOR 1/2 PENSION
ELIGIBLE FOR FULL PENSION
NOT ELIGIBLE FOR PENSION

Figure 8

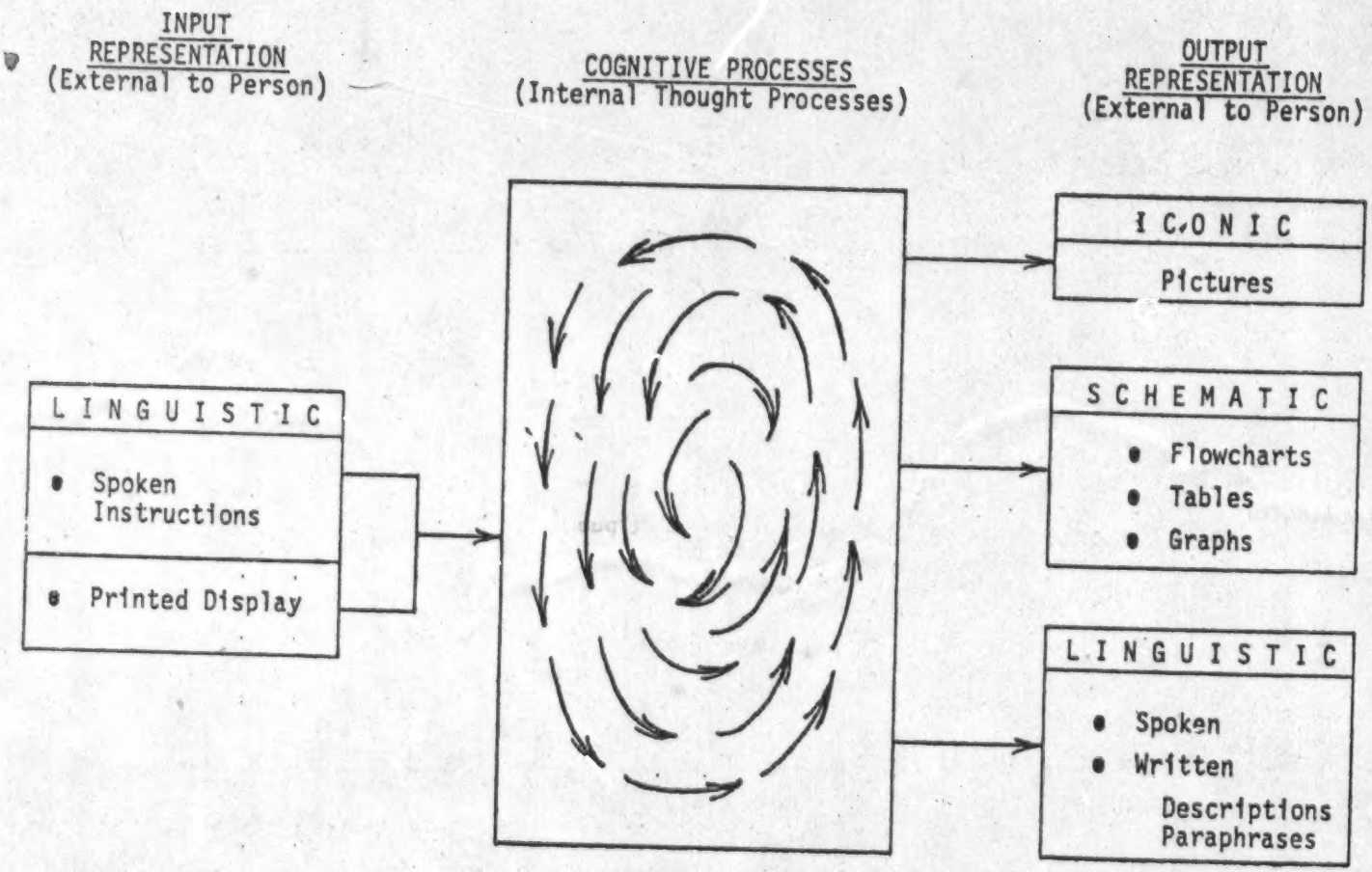

INPUT REPRESENTATION (External to Person)
COGNITIVE PROCESSES (Internal Thought Processes)
OUTPUT REPRESENTATION (External to Person)
LINGUISTIC
• Spoken Instructions
• Printed Display
ICONIC
Pictures
SCHEMATIC
• Flowcharts
• Tables
• Graphs
LINGUISTIC
• Spoken
• Written
Descriptions
Paraphrases

Figure 9

TABLE 1

Grade Equivalent Group Means

and Standard Deviations on DLRS

	READING POTENTIAL						
	VOC.		PARA.		TOTAL		
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	
EPL[1]	6.02	1.18	5.46	1.61	5.77	1.17	Part A
ESL[2]	4.40	1.10	3.79	1.19	4.11	0.99	
TOTAL[3]	5.39	1.39	4.81	1.67	5.13	1.37	

	READING						
	VOC.		PARA.		TOTAL		
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	
EPL	4.87	1.36	5.08	1.59	4.92	1.32	Part B
ESL	4.84	1.29	4.75	1.48	4.76	1.23	
TOTAL	4.86	1.33	4.95	1.55	4.86	1.28	

	AUDING						
	VOC.		PARA.		TOTAL		
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	
EPL	5.27	1.42	5.17	2.10	5.21	1.40	Part C
ESL	3.20	1.48	3.04	1.50	3.03	1.49	
TOTAL	4.47	1.76	4.34	2.15	4.36	1.78	

[1] $N_{EPL} = 71$

[2] $N_{ESL} = 45$

[3] $N_{TOT} = 116$

TABLE 2

Cell Frequencies Comparing the Numbers of Testees with RP>R Against R>RP

Part A — Vocabulary

	RP>R	R>RP	
EPL	59	10	69
ESL	10	33	43
	69	43	112

RP = R

EPL: 2

ESL: 2

Part B — Paragraphs

	RP>R	R>RP	
EPL	35	35	70
ESL	7	37	44
	42	72	114

RP= R

EPL: 1

ESL: 1

Part C — Total

	RP>R	R>RP	
EPL	53	13	66
ESL	4	36	40
	57	49	106

RP = R

EPL: 5

ESL: 5

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FIGURE CAPTIONS

Figure 1 — Overview of the Developmental Model of Literacy

Figure 2 — Comparison of Auding and Reading Performance at Five Schooling Levels

Figure 3 — Schemata Showing Relationships Among Auding & Reading Comprehension Scores as a Function of School Grade Level

Internal to the figure, #1 indicates the normative auding score for the 2nd grade, called auding at the 2nd grade level; #2 shows the normative reading score for the 2nd grade, called the 2nd grade level; #3 shows conversion of the normative auding score to a reading "potential" score by drawing a horizontal from #1 to intersect with the reading curve, and then dropping a perpendicular line to the abscissa. The example shows a reading potential score of 3rd grade. Thus the case illustrated shows a person auding and reading at the 2nd grade level, with a reading potential score of 3rd grade level.

Figure 4 — Performance of Marginally Literate Adults on Tasks Involving Simultaneous Auding & Reading of Prose While Detecting Semantic Mismatches (Part A) and Recall of Factual Information (Part B)

Figure 5 — Results of Tasks Involving Simultaneous Auding & Reading of Prose While Detecting Semantic Mismatches (Part A) and Recall of Factual Information (Part B) for 5th Grade Children and Adults of Low, Moderate, and High Literacy Ability

Figure 6 — Example of Iconic Representation

Figure 7 — Example of Schematic Representation

Figure 8 — Example of Schematic Representation

Figure 9 — In the "representation transformation" (retran) literacy training procedure, printed displays in the form of narrative prose are transformed into iconic, schematic, or another linguistic representation of the information contained in the input display.

FOOTNOTE

[1]On leave from the Human Resources Research Organization, Western Division, Monterey, California. Portions of this research were supported by Air Force Human Resources Laboratory/Technical Training Contract F 41609-75-C0014, Dr. James R. Burkett, technical monitor. Thanks to HumRRO colleagues Larry Beck, John Caylor, and Bob Hauke for comments, and to Maurlaine Jorgenson for her fine job in preparing the final manuscript.